Chapter 1

THE OCEAN MONITORING PROGRAM

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INTRODUCTION

The Orange County Sanitation District (District) operates two wastewater treatment facilities in coastal southern California. The District discharges the treated wastewater to the Pacific Ocean through an offshore, submarine outfall located off Huntington Beach and Newport Beach, California (Figure 1-1). This discharge is regulated by the US Environmental Protection Agency, Region IX (EPA) and the Regional Water Quality Control Board, Region 8 (RWQCB) under the Federal Clean Water Act, the California Ocean Plan, and the RWQCB Basin Plan. Specific discharge and monitoring requirements are contained in a National Pollutant Discharge Elimination System (NPDES) permit issued jointly by the EPA and the RWQCB (Order No. R8-2004-0062, NPDES Permit No. CA0110604). The permit requires the District to conduct an ocean monitoring program (OMP) that documents the effectiveness of the District's source control and wastewater treatment operations in protecting coastal ocean resources and beneficial uses.

A large percentage of the local economies in southern California rely on beach use and its associated recreational activities, which are highly dependent upon water quality conditions (Turbow and Jiang 2004; NOEP 2005). The region's Mediterranean climate and convenient beach access results in high, year-round public use of beaches. For example, although the highest visitation occurs during the summer months, beach usage in Huntington Beach and Newport Beach during the winter months can exceed 750,000 visitors per month. For 2007-08, total beach attendance for the cities of Huntington Beach and Newport Beach was over 18 million (Figure 1-2). Monthly mean visitations ranged from 377,000 visitors in January 2008 to 4,200,000 in July 2007. The 2007-08 monthly mean visits were nearly identical to the record monthly means (Figure 1-2).

The District's OMP has developed a substantial understanding of water quality and environment conditions along the beaches and in the area adjacent to the submarine outfall. This monitoring program has generated a large data set that provides a comprehensive picture of both natural and anthropogenic processes that affect coastal oceanography and marine biology. These data are analyzed, interpreted, and reported annually. This report presents OMP data and results from July 2007 through June 2008. This and earlier annual reports are available digitally at the District's web site (http://www.OCSD.com/about/reports/annual_reports).

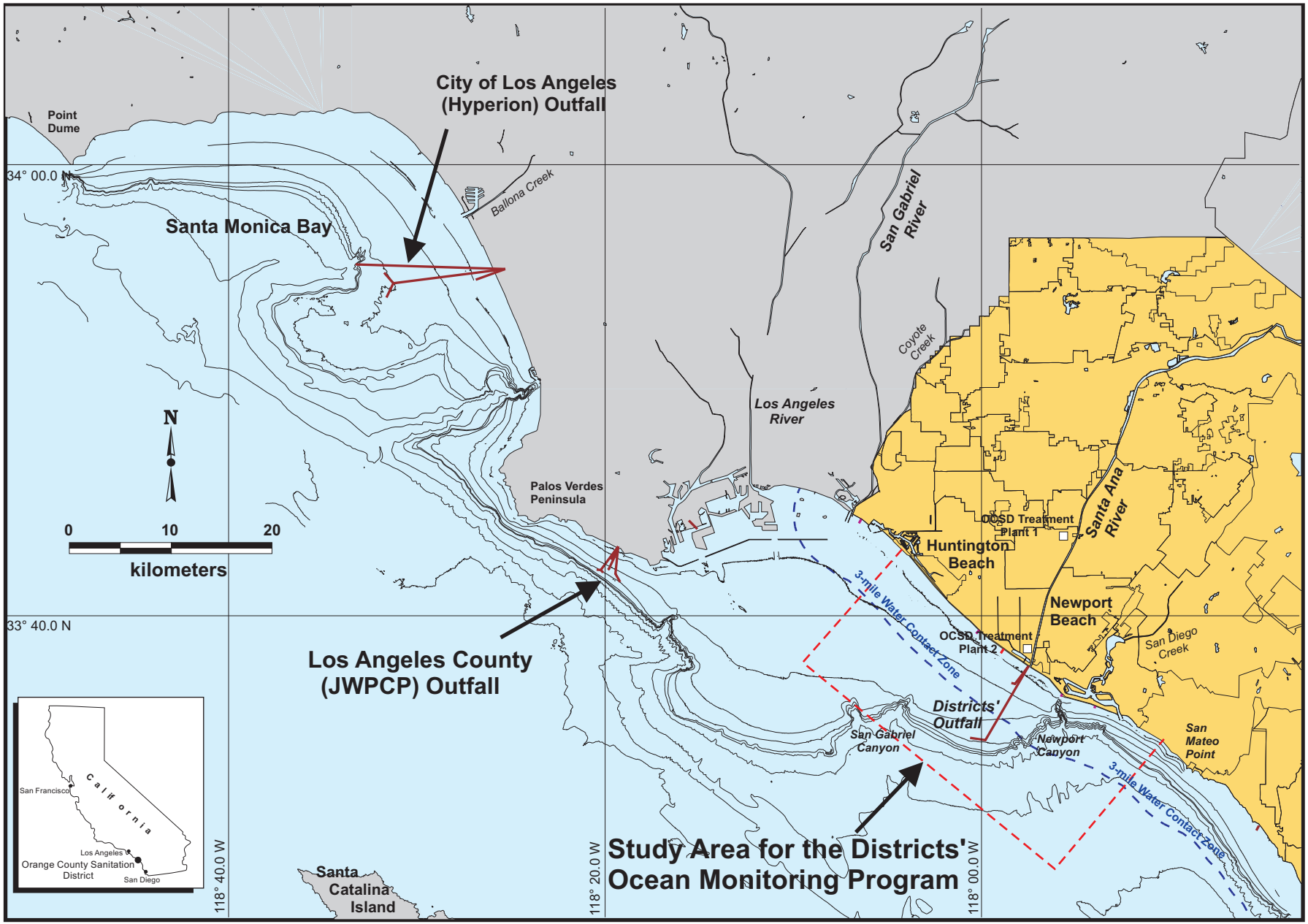

Figure 1-1. Regional setting for the District's ocean monitoring program.

Orange County Sanitation District, California.

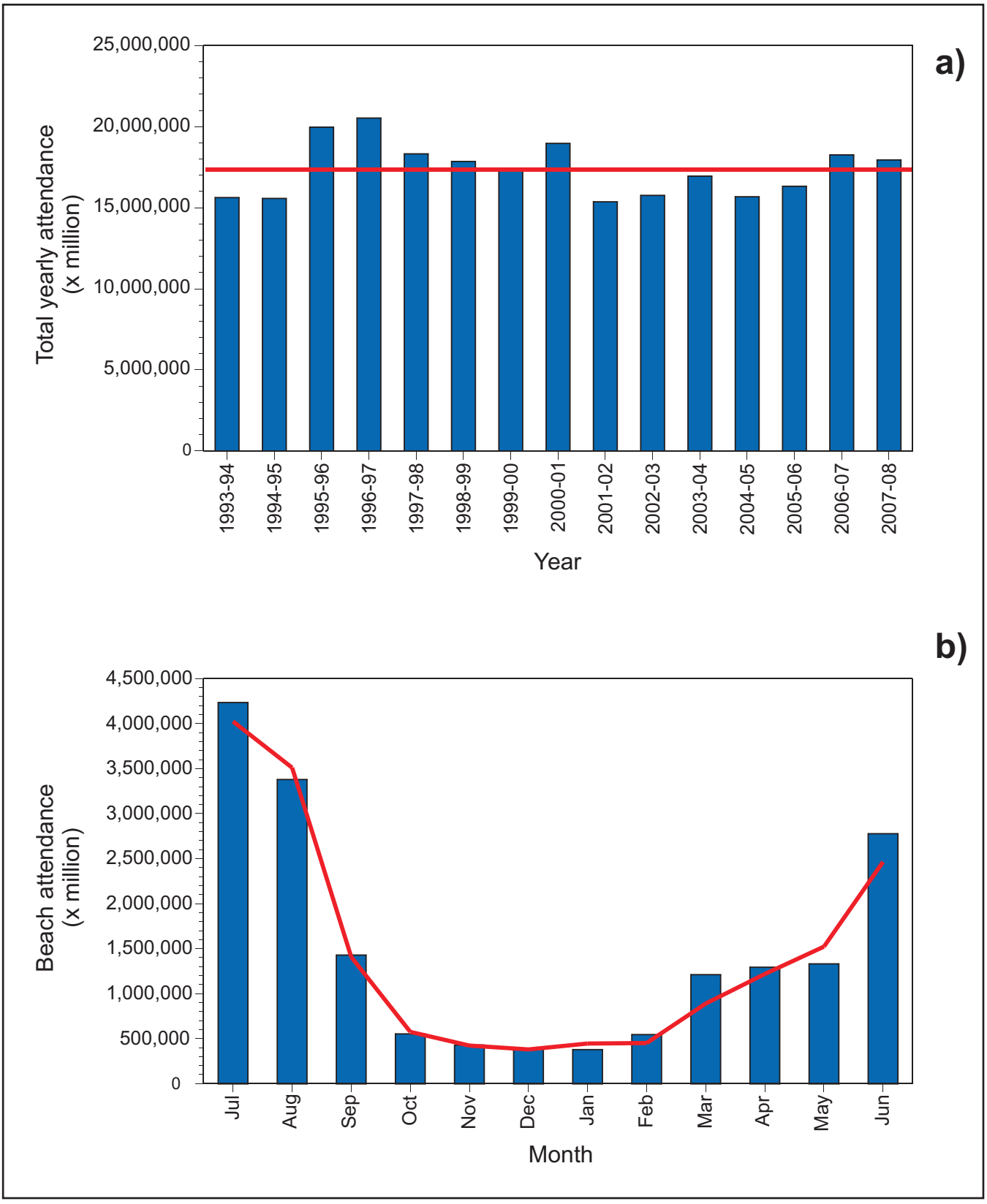

Figure 1-2. **Annual (a) and monthly (b) beach attendance for Huntington Beach and Newport Beach. Annual values represent from July 1 to June 30 of each year. Solid red line on each plot represents record mean value.**

Source: City of Huntington Beach – Marine Safety Operations, City of Newport Beach – Fire Department and

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DESCRIPTION OF THE DISTRICT'S OPERATIONS

The District's mission is to collect, process, recycle, and dispose of wastewater while protecting human health and the environment in accordance with federal, state, and local laws and regulations. These objectives are achieved through extensive industrial pre-treatment (source control), combination of primary, advanced primary, and secondary treatment processes; biosolids management, and water reuse programs. The District is presently constructing facilities that will accomplish full secondary treatment of all wastewater by 2012 (U.S. vs. OCSD 2004).

The District's two wastewater treatment plants are in Fountain Valley (Plant 1) and in Huntington Beach (Plant 2), California. Together, the two plants receive domestic sewage from approximately 80% of the county's 3.1 million residents and industrial wastewater from 750 permitted businesses within the District's service area (Figure 1-1). The treated wastewater (effluent) is discharged through the ocean outfall, which extends 7.05 km (4.38 miles) from the Huntington Beach shoreline (Figure 1-1). A 1.8 km (6,000 ft) diffuser at the end of the outfall has 503 discharge ports and is at an approximate bottom depth of 60 meters (197 ft).

Since 1999, influent volumes to the treatment plants have also included dry-weather urban runoff from 16 diverted storm water pump stations owned by the City of Huntington Beach, the City of Newport Beach, the Irvine Ranch Water District, and from three diverted flood control channels owned by the Public Works Department of Orange County. The collection and treatment of dry weather runoff is part of a regional effort to reduce bacterial pollution associated with chronic dry-weather flows that affect water quality within the watershed and cause contamination of local beaches. The flow and number of urban runoff diversion has remained steady for the last eight years.

In August 2002, the District began disinfecting the treated wastewater using chlorine to reduce indicator bacteria levels in the final effluent. The District's NPDES permit does not specify compliance limits for bacteria in the plant or the final effluent, but it does contain receiving water limits for bacteria that apply within three miles of shore. To ensure meeting the receiving water recreational contact limits, the District has operational goals for bacteria levels in the final effluent while meeting residual chlorine levels. These target limits (<180,000 MPN/100 mL total coliform, <36,000 MPN/100 mL fecal coliform, and <6,300 MPN/100 mL enterococci) are based on meeting California (i.e., AB411) single sample bacteria standards after initial dilution using a conservative 180:1 dilution of effluent following discharge (OCSD 2002). For program year 2007-08, the District consistently met the operational goals for all three indicator bacteria (Figure 1-3). Although some daily counts exceeded operational goals, the 30-day geometric mean remained well below those goals (Figure 1-3).

Historically, a small portion (approximately 10 MGD), of the final effluent had been transferred to the Orange County Water District (OCWD), where it received further (tertiary) treatment to remove residual solids. The effluent from this process was then used for public landscape irrigation (e.g., freeways, golf courses) or pumped into a local aquifer to provide a saltwater intrusion barrier. In January 2004, OCWD shut down tertiary treatment operations, began using well water for the salt-water intrusion barrier, and began construction of significant upgrades. In January of 2008 the Groundwater Replenishment

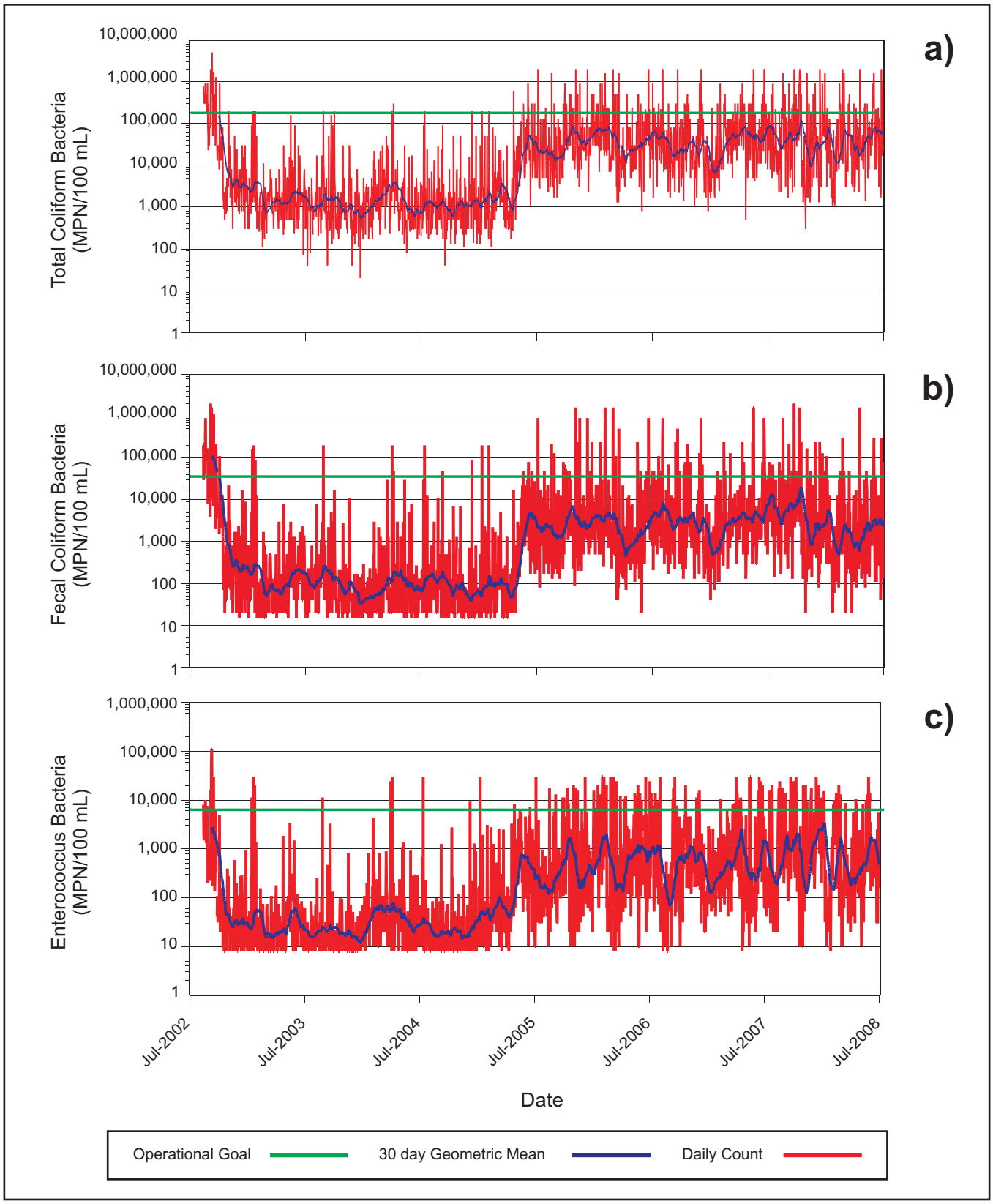

Figure 1-3. **Daily counts (MPN/100 mL) and 30-day geometric means for (a) total coliform bacteria, (b) fecal coliform bacteria, and (c) enterococcus bacteria measured in the District's final effluent from July 1, 2002 to June 30, 2008. Operational goals are 180,000 MPN/100 mL, 36,000 MPN/100 mL, and 6,300 MPN/100 mL, respectively.**

Orange County Sanitation District, California.

System (GWR) began diverting ~75 MGD of secondary effluent to OCWD. This flow is treated using microfiltration, reverse osmosis, and ultraviolet disinfection to achieve constituent levels that meet or exceed drinking water standards. Product water is pumped to existing spreading basins in Anaheim for percolation into the ground water basin and injected into an expanded seawater intrusion barrier in the cities of Fountain Valley and Huntington Beach.

During 2007-08, the wastewater treatment plants received and processed influent volumes averaging 221 million gallons per day (MGD) (OCSD 2007). These flows include dry-weather urban flow in the range of 0.7–2.4 MGD. In total, the District discharged an average of 212 MGD (8.03 $x10^8$ L/day) of treated wastewater, with an 89% reduction in suspended solids concentrations prior to discharging to the ocean (OCSD 2007). Peak flows were well below historical high flows of up to 550 MGD ($2.1x10^9$ L/day) that occurred during high rainfall periods in the winter of 1996. Seasonal and interannual differences in flow volumes are due to the variability in the amount of rainfall, infiltration of the treatment system by runoff, and the amount of reclamation. The 2007-08 rainfall (4.48 inches) was the third year in a row with a value below the Newport Harbor mean of 11.03 inches. Only December 2007, and January and February 2008 accumulated any significant rain (Figure 1-4). The annual flow from the Santa Ana River was also below the record mean flow of 25,226 cubic feet per second. Monthly average flows were well below the long-term monthly flows during every month except September 2007 and January 2008 (Figure 1-4).

Over the past three decades, wastewater discharge volumes have generally increased due to continuing population growth within the District's service area (Figure 1-5). For example, wastewater flows increased from approximately 170 to 260 MGD between 1975 and 1990. During 1991-92, average flows decreased to 221 MGD, likely due to drought conditions and consequent water conservation measures. Average flow increased to 255 MGD in 1997-98 due to high rainfall amounts, including several major storm events related to El Niño conditions. The 212 MGD flow rate for 2007- 08 is 11% lower than last year's 237 MGD. This reduction in ocean discharge reflects the operation of the GWR for six months. Next year the reduction in flow will be larger because the GWR will have been in operation for a full year. Concentrations and mass emissions for many of the wastewater constituents have declined over the past three decades as a result of changes in the District's treatment processes and source control programs. For example, concentrations of total suspended solids (TSS), biological oxygen demand (BOD), and copper (Cu) in the final effluent decreased substantially during the early 1980s (Figure 1-5). TSS discharges were about 199,000 to 220,000 lbs/day from 1975 to 1982, but decreased following the addition of activated sludge secondary treatment at Plant 1 in 1982 to present (2008) levels of approximately 58,000 lbs/day. Since 1984, TSS emission rates have been maintained between 58,000 to 108,000 lbs/day, despite increased flow associated with continued urbanization within the service area; a similar pattern was seen for BOD. Decreases in Cu in the final effluent are largely due to Source Control efforts (OCSD 2000b).

REGULATORY SETTING FOR THE OCEAN MONITORING PROGRAM

The District's permit includes a requirement to monitor influent and effluent and the receiving water. Effluent flows, constituent concentrations, and toxicity are monitored to

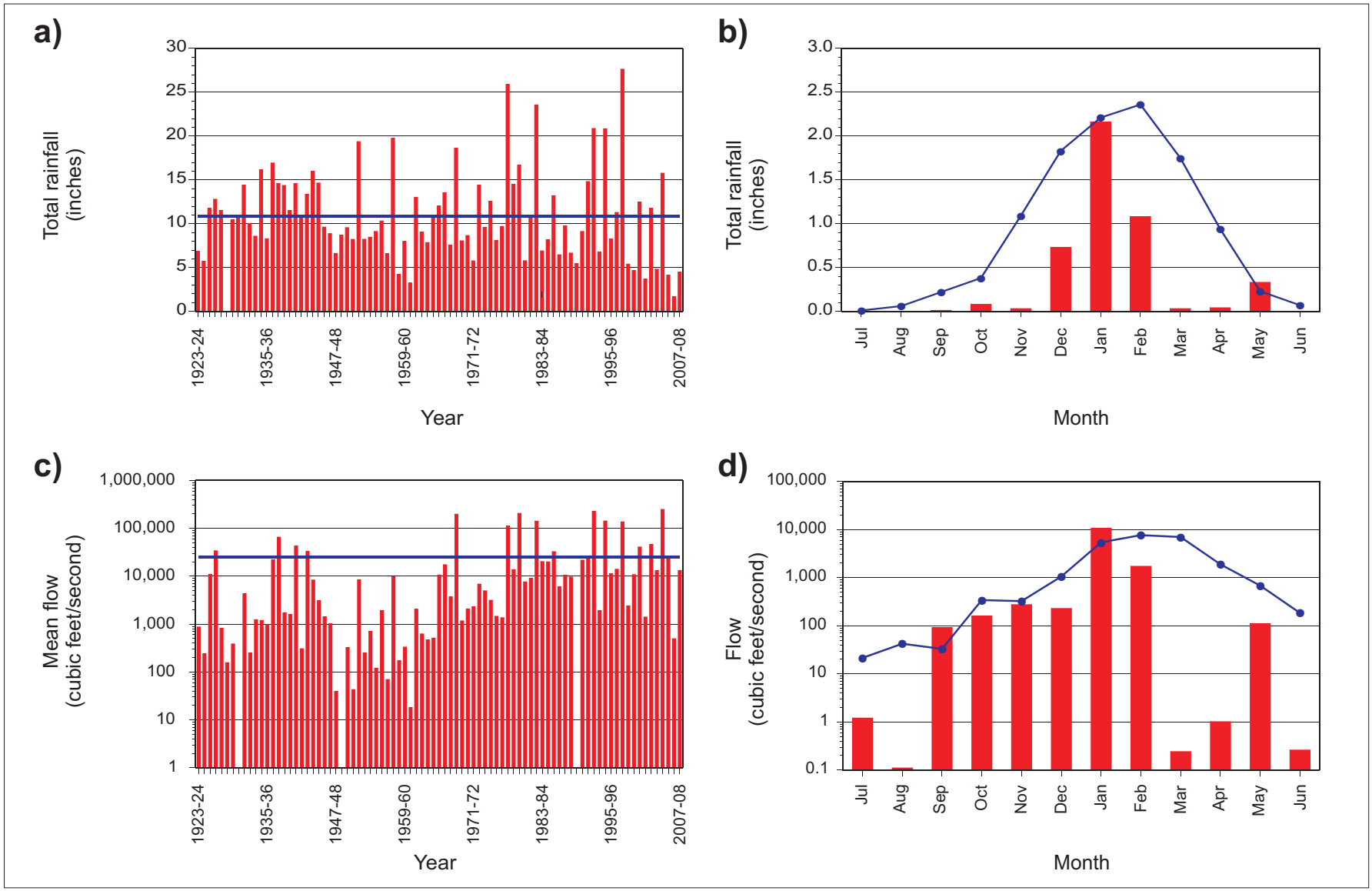

Figure 1-4. **Annual total (a) and monthly mean (b) rainfall for Newport Harbor, California with annual mean flow (c) and monthly mean flow (d) for the Santa Ana River. Annual values represent from July 1 to June 30 of each year. Solid blue line on each plot represents record mean value.**

Source: (SAR: USGS, 5th Street Station, Santa Ana, http://waterdata.usgs.gov/usa/nwis/uv?site_no=11078000**)**
(Rainfall: DWR; Newport Harbor Station), http://www.climate.water.ca.gov
Orange County Sanitation District, California.

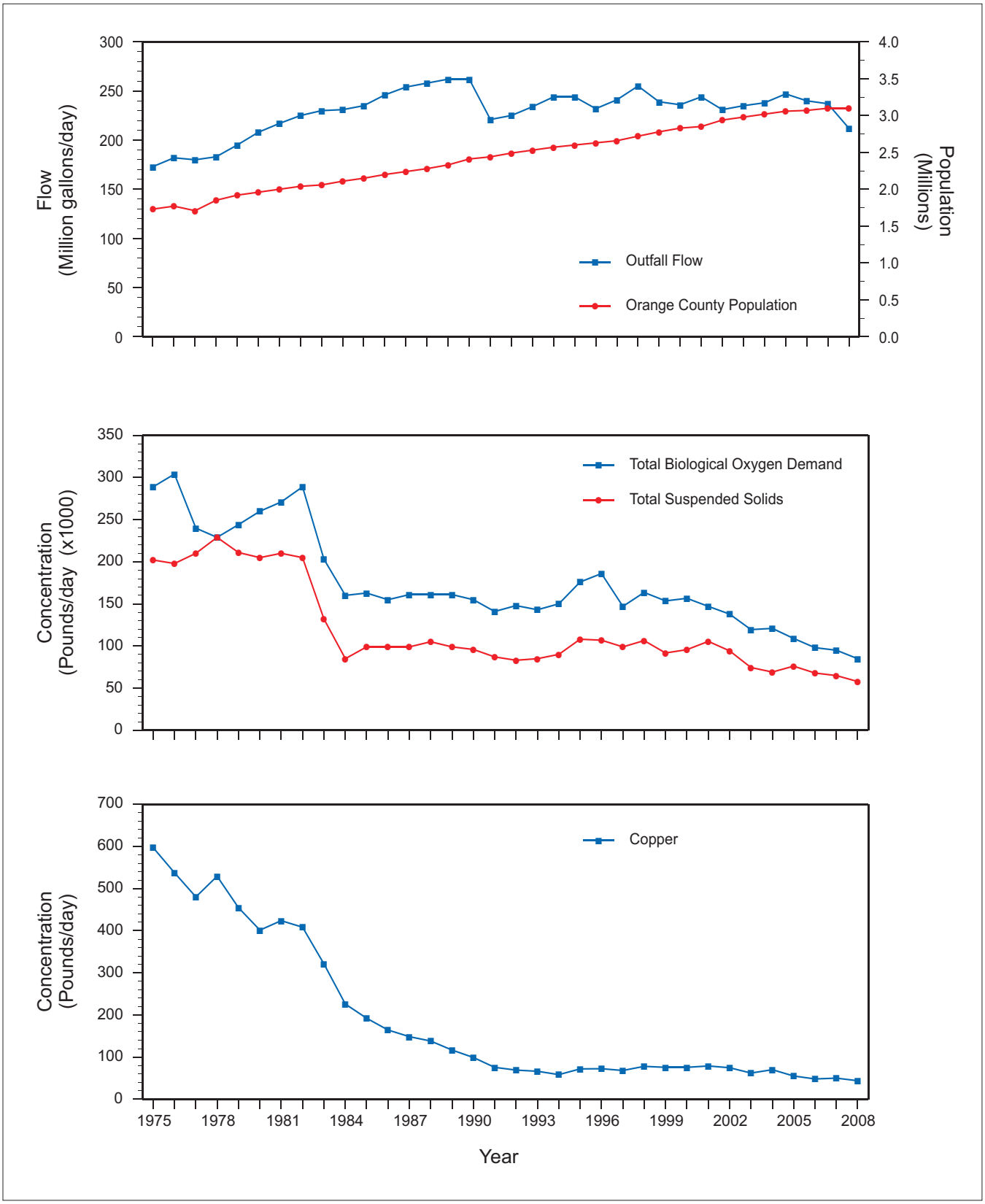

Figure 1-5. **Trends in the District's effluent flow compared to Orange County population and selected effluent constituent discharges to the San Pedro shelf region, 1975–2008.**

Orange County Sanitation District, California.

determine compliance with permit limits and to provide data for interpreting changes to receiving water conditions. Effluent quality during 2007-08 is discussed in the Operations and Maintenance Annual Report (OCSD 2007). Wastewater impacts to the coastal receiving waters are evaluated by the District's OMP based on three integrated components: Core monitoring, Strategic Process Studies (SPS), and Regional monitoring. Each of the program elements is summarized below. In addition, the District conducts other special studies not required under the existing NPDES permit. Information obtained from each of these program components is used to further the understanding of the coastal ocean environment and improve interpretations of the monitoring data.

The Core monitoring program was designed to measure compliance with permit conditions and for trends analysis. Four major components comprise the core program; coastal oceanography and water quality, sediment quality, benthic infaunal community health and fish and macroinvertebrate community health, which includes fish tissue contaminant concentrations.

The District conducts SPS to provide information on important coastal issues and processes that are not addressed by core monitoring. These studies have ranged from evaluating the physical and chemical processes that affect the fate and transport of the discharged wastewater to evaluating particle tracking and ocean circulation models to studying biological effects of the discharged effluent. Presently, the District is continuing the measurement of currents on the San Pedro Shelf and studying the effects of endocrine disrupting compounds (EDC) on fish. The latter study is being done collectively with local universities, publicly owned treatment works (POTW), and research groups.

Since 1994, the District has participated in four region-wide studies of environmental conditions within the Southern California Bight: 1994 Southern California Bight Pilot Project, Bight'98, Bight'03, and Bight '08 in the summer of 2008. The District has played a considerable role in all aspects of these regional projects, including program design, sampling, quality assurance, data analysis, and report writing. Results from these collaborative monitoring efforts provide information that is used by individual dischargers, resource managers, and the public to improve our understanding of regional-scale conditions and to provide a regional perspective for comparisons with data collected from individual point sources (http://sccwrp.org).

Other collaborative projects organized by SCCWRP include "Characteristics of Effluents from Large Municipal Wastewater Treatment Facilities" and "Comparison of Mass Emissions among Sources in the Southern California Bight." Both of these projects involve historical data mining from large POTWs including the District. Finally, the District has also been working with the Southern California Coastal Ocean Observing System (SCCOOS) to provide real time meteorological data and historical and ongoing offshore and beach water quality data to further understand region-wide oceanographic trends (http://www.sccoos.org).

The District also conducts studies not mandated by the NPDES permit. Recent examples include work on source tracking bacterial contamination and evaluating rapid tests for fecal indicator bacteria. In addition, the District is currently assessing how efficiently certain chemical constituents are removed by the treatment process at Plant 1 in an attempt to better understand GWRS. The project has been divided into three phases. The first two

phases were designed to test the Plant 1 process efficiencies without the contribution of the return flows from GWR and the third phase has been designed to include the contribution of the return flows from GWR.

ENVIRONMENTAL SETTING

The District's OMP study area is located on the southern portion of the San Pedro Shelf, adjacent to one of the most highly urbanized areas in the United States. The Shelf is composed primarily of soft sediments (sands with silts and clays) and inhabited by biological communities typical of these environments. The seafloor increases in depth gradually from the shoreline to a depth of approximately 80 meters, after which the depth increases rapidly as it slopes down to the open basin. The outfall lies on the shelf at 60 meters between the Newport and San Gabriel submarine canyons, which are located southeast and northwest, respectively (Figure 1-1). The outfall represents one of the largest artificial reefs in this coastal region and supports communities typical of hard substrates that would not otherwise be found in the study area (OCSD 2000a; CDFG 1989).

Conditions within the District's study area are affected by large and regional-scale current patterns that influence the water characteristics and the direction of water flow along the Orange County coastline. The predominant current flows in the monitoring area are up coast and down coast northeast and southeast, respectively (OCSD 1997, 1998, 2004; SAIC 2001). The water column can generally be divided in two: an upper layer from the surface to about 25 meters depth, and a lower layer below 25 meters. Upper layer currents are mostly directed down coast, while lower layer currents are typically directed up coast. The lower layer is where the wastewater is discharged.

Other natural, oceanographic processes, such as upwelling and eddies also influence the characteristics of receiving waters on the San Pedro Shelf. Tidal flows, currents, and internal waves mix and transport the District's wastewater discharge with coastal waters and sediments. Tidal currents in the study region are relatively weak compared to background (lower frequency) currents (OCSD 2001, 2004). These combined processes contribute to the variability of seawater movement within the study area.

Episodic storms, drought, and climatic cycles also influence environmental conditions and biological communities within the study area. For example, storm water runoff have a large influence on sediment movement into the study region (Brownlie and Taylor 1981; Warrick and Millikan 2003), and major storms can generate waves capable of extensive shoreline erosion, sediment resuspension, and movement of sediments along the coast as well as offshore. Some of the greatest effects are produced by wet weather cycles and periodic oceanographic events, such as El Niño and La Niña conditions and periods of draught (see OCSD 2007). The last wet period occurred over 2004-05 when 38 inches of rain fell on southern California (Figure 1.4). This was followed by a two-year dry period 2005 through 2007, with only 6 inches of rain over two years. 2007-08 was still below average with only 4.48 inches (Figure 1-4).

While many of the materials supplied to coastal waters by rivers are essential to natural biogeochemical cycles, either an excess or a deficit may have important environmental

consequences. A better understanding of the effects from cumulative changes in inputs from rivers and watersheds, particularly non-point source runoff, is important for evaluating trends in the environmental quality of coastal areas. For example, the Santa Ana and San Gabriel Rivers (Figure 1-1) transport much of the runoff from the local mountain ranges (Figure 1-4). River flows, together with urban storm water runoff, represent significant, episodic sources of freshwater, sediments, suspended particles, nutrients, and contaminants to the coastal area (Hood 1993; Grant et al. 2001).

Near shore coastal waters of the Southern California Bight receive municipal and industrial wastes from a variety of human-related sources, such as wastewater discharges, dredged material disposal, oil and gas activities, boat/vessel discharges, urban runoff, and atmospheric fallout. The majority of these are located between Point Dume and San Mateo Point (Figure 1-1). Discharges from the Los Angeles and San Gabriel Rivers are also responsible for substantial inputs of contaminants to the Southern California Bight (SCCWRP 1992; Schafer and Gossett 1988). Similarly, outflow from Newport and Anaheim Bays, which receive pollutants from urban, agricultural, and industrial runoff, as well as waste from boats and marinas within the bays, provide a potential source of contaminants to the ocean.

A goal of the District's OMP is to provide an understanding of the effects of its wastewater discharge on beneficial uses of the ocean. However, distinguishing the effects of the District's discharge from those of natural and other human influences is difficult, especially as the "signal" (impact) from the outfall has been greatly reduced since 1971. The complexities of the environmental setting and related difficulties in assigning a cause or source to a pollution event are the reasons for OCSD's extensive monitoring program. Interpretations of data related to the receiving waters monitoring program relative to other potential sources of impact are included in the chapters that follow.

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